Structural Barriers To Systems Engineering

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System Engineering Defined

SYSTEMS ENGINEERING

The efficient management of resources and design to produce a system (product) meeting the user's defined needs.

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System Architecting

- Disciplined process to progressively add depth to system architecture and component design in support of the complete breadth of system requirements
- Iterative process that continually revisits, analyzes, and updates existing design as knowledge is gained through detailed decomposition and design maturity
- A process that dynamically adapts to the constraints of the system and the constraints of management resources

Art and Science

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Structural Barriers To SE

- Programmatic
- Requirements Definition
- Unproven Technology
- Concept Of Operations
- Constraints

Primary Structural Barrier Risk Management Techniques

Programmatic Barriers

- Budget Created From Unrealistic Schedule
- Failure To Recognize Technical Authority
- Lack Of Early Engineering Engagement
  - Flawed Basis of Estimate (BOE)
  - Undisciplined Configuration Management
  - Undisciplined Information Exchange
- Tactical Versus Strategic View
  - Short Term Budget Execution
  - Life Cycle Costs Ignored

Requirements Definition

- Requirements Definition
  - User Defined Capabilities Vague Or Immeasurable
  - Life-Cycle Requirements
  - Derived & Correlated Design Requirements Not Recognized
- Unproven Technology
  - Overreaching Requirement Characterized As A Management Challenge
  - Design Dependence On Unproven Technology
  - Lack Of Alternate Design Paths Or Capability Relief

Concept of Operations

- Lack Of Early User Involvement
- Functionality Not Derived From Capabilities
- Reliability & Maintainability Not Understood

Constraints

- Non-Developmental Items
- Capital Investment In Logistic & Supply Chain
- Legacy Compatibility Requirements
- Proprietary Data, Qualifications, & Use Data
- Sub-Contractor Access & Control

Constraints Limit Performance

Risk Mitigation

Risk Identification And Mitigation Is Required On All Programs

However, Poor Implementation And Understanding Of Risk Management Has Resulted In Unacceptable Level Of Risk Assumption

Primary Structural Barrier Risk Management Techniques

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DOD RM Handbook

A common misconception, and program office practice, concerning risk management is to identify and track issues (vice risks), and then manage the consequences (vice the root causes). This practice tends to mask true risks, and it serves to track rather than resolve or mitigate risks.

Risk Defined

DOD Risk Management Guide

"Risk is a measure of future uncertainties in achieving program performance goals and objectives within defined cost, schedule and performance constraints."

RISK IS NOT:
Lack of Oversight, Failure to Plan, or Unrealistic Performance Goals

Risk Management

- Risk Management Is Only A Subset Of Project Management
- Risk Identification
  - Poorly Understood
  - Incorrectly Implemented
- Risk Mitigation Plans
  - Inadequate
  - Outside Daily Program Management
- Risk Realization Totally Ignored

Risk Management Programs Require Risky Programs

Risk Avoidance Is The Goal

- Historically – All Programs Have Contained Unknown Elements Known As Risk
- Risk Assumption Has Replaced Risk Avoidance
- Gambling Has Replaced Management
- Risk Tolerance Has Increased
- Risk Acceptance Authority Not Aligned With Responsibilities
- Result: Failures And Losses On The Rise

Fundamental Question
Are You Willing To Let Other People Gamble With Your Money?

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Program Management By The Book

- Requirements Must Be Achievable And Documented
- Historically Derived Basis Of Estimate
- Integrated Master Schedule
  - All Tasks Are Planned And Linked
  - Well Constructed IAW ANSI 748
  - Critical Path Understood And Managed
  - Fully Integrated Supplier And Government Schedule Dependencies
- Integrated Data Environment
  - Deliverables Identified In Contractual Language
  - Deliverables Integrated Into Master Schedule
- Configuration Management Established & Active
- Timely Problem Resolution Across Contractual Lines
- Alternate Design Paths For Critical Technologies

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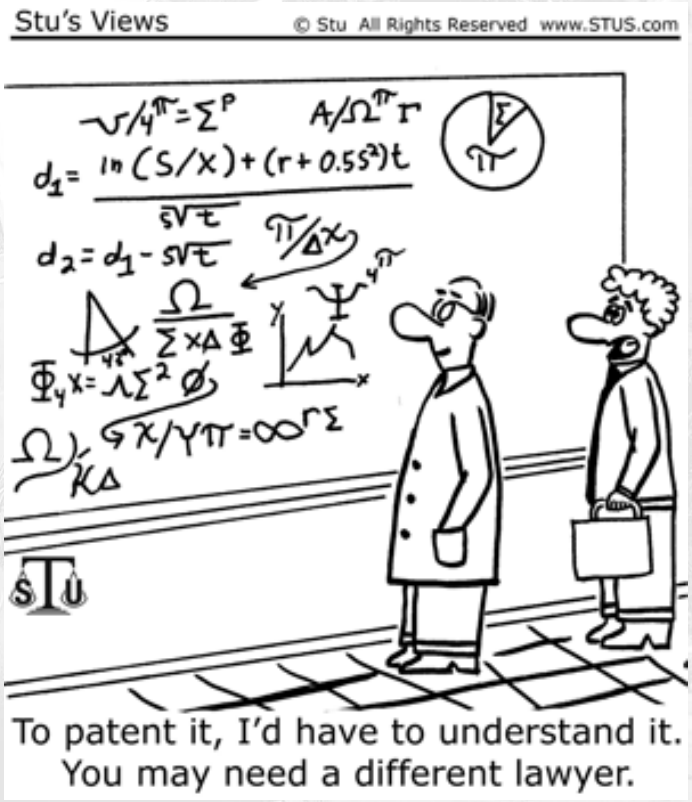
Trading Cost-Schedule-Performance Is A Ponzi Scheme



DOD Handbook RM Objective

The objective of a well-managed risk management program is to provide a repeatable process for balancing cost, schedule, and performance goals within program funding, especially on programs with designs that approach or exceed the state-of-the-art or have tightly constrained or optimistic cost, schedule, and performance goals…

…Successful risk management depends on the knowledge gleaned from assessments of all aspects of the program…

Categories Of Risk

Risk	
Technical	Critical Design Elements Depend On Technology That Is Just Not Achievable. Caused By Overreaching Performance Requirements Embedded In KPPs.
Programmatic	Resource Estimates (Budget & Schedule) Too Low. Caused By Insufficient BOE Or Optimism.

- Technical Risk Against KPPs & Thresholds Yields No Trade Space
- Result: No Resource Increases Will Eliminate Technical Risk. True Technical Risk Will Always Result In A Requirements Disconnect When Realized.
- True Technical Risk Requires Alternate Design Paths That Deliver Lower, But Acceptable, Levels Of Performance
- Minimum Acceptable Performance, And Design, Must Be Achievable Within Current State Of Technology.

There Must Be Trade Space

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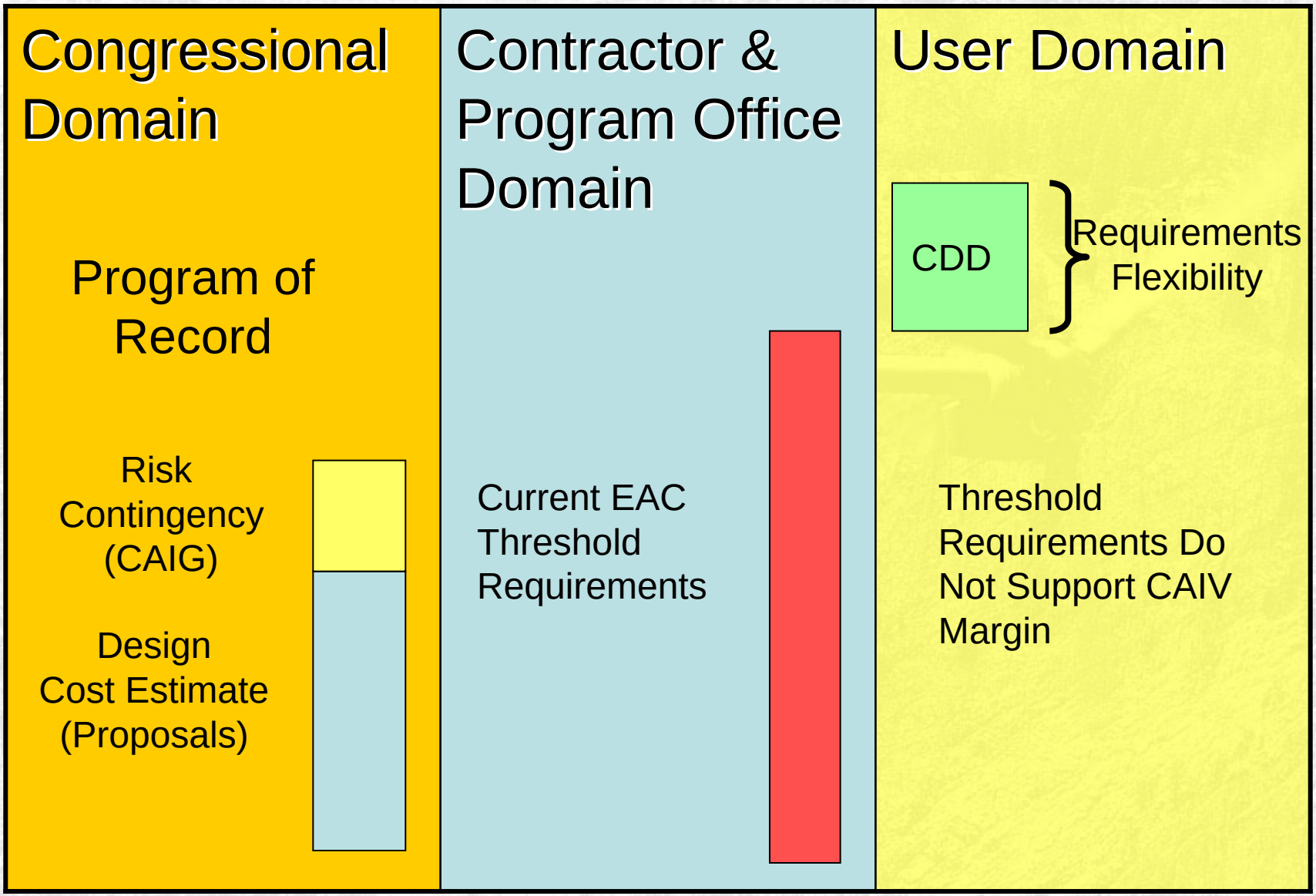

Third Law Of Risk Management

NAVAIR

NASA PM Challenge

Hope springs eternal

…until the spring dries up.

Ineffective Mitigation Paths

- Technical
  - Balance Design Against Unproven Technology
  - Pursue Single Design Path Hoping Testing Will Show Compliance
  - Carry Significant (RED) Risk Beyond Design Closure (Roughly PDR)
- Execution
  - Hope For Optimistic Performance Through Management Challenges
  - Shift Risk To Suppliers In Firm Fixed Price Contracts
  - Fail To Include All Aspect Of Rebaseline In New EAC

Effective Risk Mitigation Plan

- Risk Realization MUST Be Part Of Risk Mitigation Strategy
- Risk Mitigation Steps Must Address Root Cause Uncertainty
  - Technical: Demonstrate Improved Performance Predictions Or Alternate Design Path
  - Execution: Improve Resource Estimates
- Technical Performance Measures (TPM) Are Essential To Mitigating Technical Risk
- Task Identification Is Essential to Mitigating Execution Risk

Risk Mitigation Steps Should Not Be A Way To Buy Time In The Hope The Risk Will Be Eliminated

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Fourth Law Of Risk Management

You Get What You Pay For…

First Corollary:

You Pay For Nothing-You Get Nothing

Risk Mitigation Costs

- The Funding To Resolve Risks Cannot Be Another Resource Risk
- Risk Mitigation Plans Are Unplanned Work
- Unplanned Work Requires MR To Execute
- Risk Mitigation Impacts Resources Already Dedicated To Identified Tasks
- Unfunded Risk Mitigation Is Unresolved Risk

Risk Mitigation Is A "Pay Me Now Or Pay Me Later" Decision

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SE Project Management

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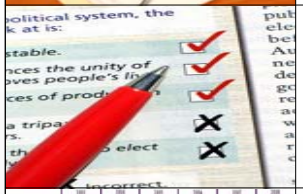
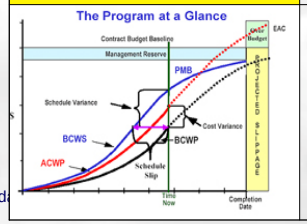
NASA PM Challenge

	Contractually Binding Commitment To Project Management Through Systems Engineering
	Well Specified Design, Build, And Acceptance Criteria
	Well Documented Integrated Master Schedule (IMS) & Work Breakdown Structure (WBS)
	Linked Contractor/Government/Suppliers IMS With Dependencies, Deliverables, And Resource Limitations
	Event Driven Engineering Reviews Documented In Contractor/Government SEP
	Earn Value Assigned By Technical Experts

Summary

- Risks Are Rooted In Uncertainty
- Disciplined Use Of PM Tools Is Required To Identify Areas Of Uncertainty (True Risks)
- Historical Execution And Standard Design Practices Normalize Optimism
- Money And Time Doesn't Mitigate All Technical Risk-Requirement Relief Only Solution
- Requirements Trade Space Must Exist
- Mitigation Plans Must Attack Root Cause Of Risk-Uncertainty


QUESTIONS?